

What is claimed is:

1. A method for encapsulating or embedding a component in a matrix comprising:

- 5
- a. obtaining a formable mixture by admixing ingredients comprising at least one plasticizable matrix material, a liquid encapsulant component, said liquid encapsulant component comprising an encapsulant and a liquid plasticizer, and at least one component for controlling the rate of release of the encapsulant, wherein said plasticizable matrix material is plasticizable by said liquid plasticizer at a temperature which does not substantially destroy said encapsulant, said admixing being under low shear and low temperature conditions to plasticize the plasticizable material without substantially destroying the encapsulant to obtain a substantially homogeneous plasticized, viscoelastic, formable mixture,
- 10
- b. forming said formable mixture into pieces, and
- c. drying said pieces,

wherein said liquid encapsulant component provides at least a substantial portion of the liquid plasticizer for forming said plasticized mixture.

2. A method as claimed in claim 1 wherein said admixing is conducted at a temperature of less than or equal to about 50°C.

3. A method as claimed in claim 2 wherein the liquid plasticizer content of said liquid encapsulant component is at least about 50 % by weight, based upon the weight of said liquid encapsulant component.

4. A method as claimed in claim 2 wherein the liquid plasticizer content of said liquid encapsulant component is sufficient to form a substantially

homogenous formable dough upon admixture of said liquid encapsulant component with said plasticizable matrix material.

5. A method as claimed in claim 4 wherein the liquid plasticizer content of said formable dough is from about 10% by weight to about 50% by weight, based upon the weight of the formable dough.

6. A method as claimed in claim 2 wherein liquid plasticizer in addition to the liquid plasticizer provided by said liquid encapsulant component is admixed with said plasticizable matrix material to obtain said formable mixture, the formable mixture is obtained in an extruder and extruded through a die without substantially expanding the formable mixture, and the extrudate is cut into pieces.

7. A method as claimed in claim 2 wherein the formable mixture is extruded to obtain an extrudate, the extrudate is cut into pieces, and the pieces are dried to a shelf-stable moisture content of less than about 10% by weight, based upon the weight of the pieces.

8. A method as claimed in claim 2 wherein said admixing to obtain said formable mixture is conducted at a pressure of from about 1 bar to about 100 bar.

9. A method as claimed in claim 2 wherein an additional encapsulant, in solid form, is admixed with said plasticizable matrix material.

10. A method as claimed in claim 9 wherein said additional encapsulant is coated with a film-forming material prior to admixing with said plasticizable matrix material.

11. A method as claimed in claim 2 wherein said formable mixture is obtained by admixing said ingredients in a continuous mixer to obtain a crumbly dough, feeding the crumbly dough to an extruder, and plasticizing the crumbly dough into

a continuous, substantially homogeneous plasticized dough in said extruder, extruding the substantially homogeneous dough through an extruder die, and cutting the extrudate into individual pieces.

12. A method as claimed in claim 1 wherein said pieces are coated with a film-forming material.

13. A method as claimed in claim 2 wherein said plasticizable matrix material comprises either semolina or flour from cookies or crackers, and said liquid plasticizer comprises water.

14. A method as claimed in claim 13 wherein said liquid encapsulant component comprises at least one member selected from the group consisting of enzymes, vitamins, micronutrients, and live microorganisms.

15. A method as claimed in claim 2 wherein said at least one release-rate controlling component is a hydrophobic component.

16. A method as claimed in claim 15 wherein said hydrophobic component is at least one member selected from the group consisting of fats, oils, waxes, fatty acids, emulsifiers, polyolefins, polyurethanes, polyvinylchloride, paraffins, polyvinyl acetates, and modified starches.

17. A method as claimed in claim 2 wherein said at least one release-rate controlling component is a high water binding capacity component.

18. A method as claimed in claim 10 wherein said high water binding capacity component is selected from the group consisting of proteins, and hydrocolloids.

19. A method as claimed in claim 2 wherein the amount of said at least one release-rate controlling agent is from about 5 % by weight to about 50 % by weight,

based upon the weight of said plasticizable matrix material.

20. A method as claimed in claim 13 wherein the semolina or cookie flour or cracker flour content of said pieces is at least about 40% by weight, based upon the weight of said dry pieces.

5
21. An encapsulated product obtained by the method of claim 1 which is in substantially non-expanded, particulate form, and wherein said encapsulant is at least one heat sensitive pharmaceutical component, nutraceutical component, nutritional component, flavor component, fragrance component, or biologically active component, and said plasticizable matrix material comprises durum wheat.

22. An encapsulated product as claimed in claim 21 wherein said encapsulant comprises at least one member selected from the group consisting of enzymes, vitamins, micronutrients, and live microorganisms.

23. An encapsulated product obtained by the method of claim 1 which is in substantially non-expanded, particulate form, and wherein said encapsulant is at least one heat sensitive pharmaceutical component, nutraceutical component, nutritional component, flavor component, fragrance component, or biologically active component, and said plasticizable matrix material comprises ground cookies or ground crackers.

20
24. An encapsulated product as claimed in claim 23 wherein said encapsulant comprises at least one member selected from the group consisting of enzymes, vitamins, micronutrients, and live microorganisms.

7.34 Sub C2
25
25. An encapsulated product obtained by the method of claim 1 wherein said encapsulant is at least one member selected from the group consisting of: acepromazine acetaminophen, acetohexamide, acetohydroxamic acid, acetylcholine, acetylcysteine acyclovir, albendazole, alclometasone dipropionate,

Sub
C-2
int

5

10

20

25

30

allopurinol, alprazolam, alprostadil, amcinoide, amantadine, amdinocillin,
amikacin amiloride, aminocaproic acid, aminophylline, aminosalicylate ,
aminosalicyllic acid, amitriptyline hydrochloride, ammonium chloride,
amobarbital, amodiaquine hydrochloride, amoxapine, amoxicillin, amphetamine
sulfate, amphotericin, ampicillin amprolium, acetazolamide acetyldigoxin,
acetylsalicylic acid, anileridine, anthraline, antipyrine, antivenin, apomorphine,
apraclonidine, ascorbic acid, aspirin, acromycin atropine, amoxycillin anipamil,
azaperone azatadine maleate, azathioprine, azithromycin, aztreonam,
bacampicillin, bacitracin, baclofen, barium salts, beclomethasone diproionate,
belladonna extract, bendroflumethiazide, benoxinate hydrochloride, benzethonium
chloride , benzocaine, benzonatate benzthiazide, benztropine mesylate, betain,
betamethasone, betaxolol , betanechol chloride, biotin, biperiden, bisacodyl,
bismuth, botulism antitoxin, bromocriptine mesylate, bromodiphenhydramine
hydrochloride, bumetanide, bupivacaine, busulfan butabarbital sodium, butalbital,
combinations of butalbital, caffeine and aspirin and codeine, beta-carotene,
calcifediol, calcium carbonate, calcium citrate, calcium salts, candicidin,
captopril, carbachol, carbamazepine, carbenicillin indanyl sodium, carbidopa,
carbinoxamine maleate, carboprost tromethamine, carboxymethylcellulose,
carisoprodol, casanthranol, cascara, castor oil, cefaclor, cefadroxil, cefamandole
nafate, cefazolin, cefixime, cefoperazone, cefotaxime, cefprozil, ceftazidime,
cefuroxime axetil, cephalixin, cephradine, chlorambucil, chloramphenicol,
chlordiazepoxide, chloroquine phosphate, chlormadinone acetate, chlorothiazide,
chlorpheniramine maleate, chloroxylenol, chlorpromazin, chlorpropamide,
chlorprothixene, chlorprothixene, chlortetracycline bisulfate, chlortetracycline
hydrochloride, chlorthalidone, chlorzoxazone, cholecalciferol, cholera vaccine,
chromic chloride, chymotrypsin, cimetidine, cinoxazin, cinoxate, ciprofloxacin,
cisplatin, clarithromycin, clavulanate potassium, clemastine fumarate, clidinium
bromide, clindamycin hydrochloride, -palmitate and -phosphate, clioquinol,
clofazimine, clofibrate, clomiphene citrate, clonazepam, cinnarizine, clonidine
hydrochloride, clorsulon, clotrimazole, cloxacillin sodium, cyanocobalamin,
cocaine, coccidioidin, cod liver oil, codeine, colchicine, colestipol, corticotropin,

7.34

7.34

pg 4

corisone acetate, cyclacillin, cyclizine hydrochloride, cyclobenzaprine
 hydrochloride, cyclophosphamide, cycloserine, cyclosporine, cyproheptadine
 hydrochloride, cysteine hydrochloride, danazol, dapsone, dehydrocholic acid,
 demeclocycline, desipramine, desoximetasone, desoxycorticosterone acetate,
 5 dexamethasone, dexchlorpheniramine maleate, Dexpanthenol,
 dextroamphetamine, dextromethorphan, diazepam, diazoxide, dibucaine,
 dichlorphenamide, dicloxacillin sodium, dicyclomine, dienestrol, diethylpropion
 hydrochloride, diethylstilbestrol, diflunisal, digitalis, dicoumarol, digitoxin,
 digoxin, dihydroergotamine, dihydrostreptomycin, dihydrotachysterol,
 10 dihydroxyaluminium aminoacetate, dihydroxyaluminium sodium carbonate,
 diltiazem hydrochloride, dimenhydrinate, dimercaprol, diphenhydramine
 hydrochloride, diphenoxylate hydrochloride, diphteria antitoxin, dipyrindamole,
 disopyramide phosphate, disulfiram, dobutamine hydrochloride, docusate calcium,
 docusate sodium, dopamine hydrochloride, doxepin hydrochloride, doxycycline,
 doxycycline hyclate, doxylamine succinate, dronabinol, droperidol, drotaverine,
 dydrogesterone, dyphylline, guaifenesin, enalapril maleate, analaprilat, ephedrine,
 epinephrine, equilin, ergocalciferol, ergoloid mesylates, ergonovine maleate,
 15 ergotamine tartrate, erythrityl tetranitrate, erythromycin, estradiol, estriol,
 estrogen, estrone, estropipate, ethcrynac acid, ethambutol hydrochloride,
 20 ethchlorvynol, ethinyl estradiol, ethionamide, ethopropazine hydrochloride,
 ethotoin, ethynodiol diacetate, etidronate disodium, etoposide, eugenol,
 famotidine, fenopropfen, ferrous fumarate, ferrous gluconate, ferrous sulfate,
 flucytosine, fludrocortisone acetate, flunisolide, fluocinolone acetonide,
 fluocinonide, fluorescein sodium, fluorometolone, fluorouracil, fluoxymesterone,
 25 fluphenazine, flurandrenolide, flurazepam, flurbiprofen, folic acid, furazolidone,
 flunitrazepam, furosemide, gemfibrozil, gentamicin, gentian violet, glutarate,
 glutethimide, glycopyrrolate, chorionic gonadotropin, gramicidin, griseofulvin,
 guaifenesin, guanabenz, guanadrel sulfate, halazone, haloperidol, haloprogin,
 halothane, heparin calcium, hepatitis virus vaccine, hetacillin potassium,
 30 hexylresorcinol, histamine phosphate, histidine, homatropine, histoplasmin,
 hydralazine hydrochloride, hydrochlorothiazide, hydrocodone bitartrate,

minoxidil, mitomycin, mitotane, molindone hydrochloride, monobenzene,
 morphine sulfate, mupirocin, medazepam, mefruside, methandrostenolone,
 methylsulfadiazine, nadolol, nafcillin, nafcillin sodium, nalidixic acid, nalorphine,
 naloxone, nandrolone decanoate, nandrolone phenpropionate, naproxen,
 natamycin, neomycin, neomycin sulfate, neostimine bromide, niacin,
 nitrofurantoin, nalidixic acid, nifedipine, nitrazepam, nitrofurantoin,
 nitroglycerine, nitromerson, nizatidine, nonoxynol 9, norethindrone,
 norethindrone acetate, norfloxacin, norgestrel, nortriptyline hydrochloride,
 noscapine, novobiocin sodium, nystatin, opium, oxacillin sodium, oxamniquine,
 oxandrolone, oxazepam, oxprenolol hydrochloride, oxtriphylline, oxybenzone,
 oxybutynin chloride, oxycodone hydrochloride, oxycodone, oxymetazoline
 hydrochloride, oxymetholone, oxymorphone hydrochloride, oxyphenbutazone,
 oxytetracycline, padimate, pancreatin, pancrelipase, papain, panthenol, papaverin
 hydrochloride, parachlorophenol, paramethasone acetate, paregoric, paromomycin
 sulfate, penicillamine, penicillin, penicillin derivatives, pentaerythritol tetranitrate,
 pentazocine, pentazocine hydrochloride, pentazocine salts, pentobarbital sodium,
 perphenazine, pertussis, phenacetamide, phenazopyridine hydrochloride,
 phendimetrazine tartrate, phenelzine sulfate, phenmetrazine hydrochloride,
 phenobarbital, phenophtalein, phenoxybenzamine hydrochloride, phentermine
 hydrochloride, phenylalanine, phenylbutazone, phenylephrine hydrochloride,
 phenylpropanolamine hydrochloride, physostigmine, phytonadione, pilocarpine,
 pimozone, pindolol, piperazine, piroxicam, plicamycin, poliovirus vaccine
 inactivated, polycarbophil, polymyxin b sulfate, polythiazide, potassium chloride,
 potassium citrate, potassium gluconate, potassium iodine, potassium sodium
 tartrate, povidone iodine, pralidoxime chloride, pramoxine hydrochloride,
 pramexam, prazepam, praziquantel, prazosin hydrochloride, prazosin
 hydrochloride, prednisolone, prilocaine, primaquine, primidone, probenecid,
 probucol, procainamide hydrochloride, procaine hydrochloride, procarbazine
 hydrochloride, prochlorperazine, prochlorperazine maleate, procyclidine
 hydrochloride, progesterone, proline, promazine, promazine hydrochloride,
 promazine, promethazine, promethazine hydrochloride, propafenone

Sub
C 3
Cont

5

10

15

20

25

30

hydrochloride, propantheline, proparacaine hydrochloride, propoxycaine
hydrochloride, propoxyphene hydrochloride, propoxyphene napsylate, propanolol
hydrochloride, propylidone, propylthiouracil, propylthiouracil, protriptyline
hydrochloride, pseudoephedrine hydrochloride, pumice, pyrantel pamoate,
pyrazinamide, pyrethrum extract, pyridostigmine bromide, pyridoxine
hydrochloride, pyrilamine maleate, pyrimethamine, pyroxylin, pyrvinium
pamoate, phenacetin, phenytoin, prednisone, uinidine gluconate, quinidine sulfate,
rabies vaccine, racepinephrine ranitidine, rauwolfia serpentina, resorcinol,
ribavirin, riboflavin, rifampin, ritodrine, rubella virus vaccine, saccharin,
saccharin sodium, salicylamide, salicylic acid, salsalata, scopolamine, secobarbital
sodium, selenius acid, selenium sulfate, sennaserine, simethicone, sodium
ascorbate, sodium bicarbonate, sodium fluoride, sodium gluconate, sodium iodide,
sodium lactate, sodium nitrite, sodium ditroprusside, sodium salicylate,
spironolactone, stannozolol, streptomycin, sucralfate, sulfacetamide, sulfadiazine,
reserpine, sulfadioxine, sulfamerazine, sulfamethazine, sulfamethizole,
sulfamethoxazole, sulfamethoxydiazine, sulfapyridin, sulfasalazine, sulfaperin,
sulfathiazole, sulfisoxazole, sulfinpyrazone, sulindac, suprofen, stilains, tamoxifen
citrate, temacepam, terbutaline sulfate, terfenadine, terpin, testolacton,
testosterone, tolazamide, tolbutamide, tetracaine, tetracycline, tetrahydrocycline,
theophylline, thiabendazole, thiamine hydrochloride, thiamin, thiamylal,
thiethylperazine thimerosal, thioguanine, thioridazine hydrochloride, thistrepton,
thiotepa, thiothixene, threonine, thyroid, ticarcillin, timolol, tioconazole,
titaniumdioxide, tolazamide, tolbutamide, tolmetin, tolnaftate, trazodone
hydrochloride, tretinoin, triacetin, triamcinolone, triamterene, triazolam,
trichorfon, trichlormethiazide, trientine hydrochloride, trifluoperazine
hydrochloride, triflupromazine, trihexyphenidyl hydrochloride, trimeprazine
tartrate, trimethadione, trimethobenzamide hydrochloride, trimethoprim,
trioxsalen, tripteramine, triprolidine, trisulfapyrimidine, tropicamide, trypsin,
tryptohan, tuberculin, tyloxapol, tyropanoate sodium, tyrosine, tyrothricin,
thyrothricin betnamethasone, thiotic acid, sotalol, salbutamol, norfenefrine,
silymarin, dihydroergotamine, buflomedil, etofibrate, indometacin, urea valine,

valproic acid, vancomycin hydrochloride, vasopressin, verapamil, vidarabine,
 vinblastine, vincristine, vitamins, warfarin, yellow fever vaccine, zinc acetate, zinc
 carbonate, zinc chloride, zinc gluconate, beta acetyl digoxin, piroxicam,
 haloperidol, ISMN, amitriptylin, diclofenac, nifedipine, verapamil, pyritinol,
 5 nitrendipin, doxycycline, bromhexine, methylprednisolone, clonidine, fenofibrate,
 allopurinol, pirenepine, levothyroxin, tamoxifen, metildigoxin, o-(beta-
 hydroxyethyl)-rutoside, propicillin, aciclovir mononitrate, paracetamol,
 2 naftidrofuryl, pentoxifylline, propafenone, acebutolol, L-thyroxin, tramadol,
 bromocriptine, loperamide, ketotifen, fenoterol, cadobelisate, propanolol,
 10 enalaprilhydrogen maleate, bezafibrate, ISDN, gallopamil, xantinol nicotinate,
 digitoxin, flunitrazepam, bencyclane, dexapanthenol, pindolol, lorazepam,
 diltiazem, piracetam, phenoxymethylpenicillin, furosemide, bromazepam,
 flunarizin, erythromycin, metoclopramide, acetaminophen, ranitidine, biperiden,
 metamizole, doxepin, dipotassium chlorazepate, tetrazepam, estramustine
 15 phosphat, terbutaline, captopril, maprotiline, prazosin, atenolol, glibenclamide,
 cefaclor, etilfrine, cimetidine, theophylline, hydromorphone, ibuprofen,
 primidone, clobazam, oxaceprol, medroxyprogesterone, flecainid, pyridoxal 5
 phosphat glutamate, himechromone, etofylline clofibrate, vincamine,
 cinnarizine, diazepam, ketoprofen, flupentixol, molsimine, glibornuride,
 20 dimetinden, melperone, soquinolol, dihydrocodeine, clomethiazole, clemastine,
 glisoxepide, kallidinogenase, oxyfedrine, baclofen, carboxymethylcysteine,
 thioridazine, betahistine, L-tryptophan, murtol, bromelaine, prenylamine,
 salazosulfapyridine, astemizol, sulpiride, benzerazide, dibenzepine, acetylsalicylic
 acid, miconazol, nystatin, ketoconazole, sodium picosulfate, coltyramine,
 25 gemfibrocil, rifampicin, fluocortolone, mexiletin, amoxicillin, terfenadrin,
 mucopolysaccharide polysulfate, triazolam, mianserin, tiaprofenic acid,
 amezinium methylsulfate, mefloquine, probucol, quinidine, carbamazepine, L-
 aspartate, penbutolol, piretanide, aescin amitriptyline, cyproterone, sodium
 valproinate, mebeverine, bisacodyl, 5-aminosalicylic acid, dihydralazine,
 30 magaldrate, phenprocoumon, amantadine, naproxen, carteolol, famotidine,
 methyldopa, auranofine, estriol, nadolol, levomepromazine, doxorubicin,

medofenoxate, azathioprine, flutamide, norfloxacin, fendiline, and prajmalium bitartrate.

26. An encapsulated product obtained by the method of claim 1 wherein said encapsulant is at least one member selected from the group consisting of antioxidants, phytochemicals, hormones, vitamins, pro-vitamins, minerals, microorganisms, prebiotics, probiotics, trace elements, essential and/or highly unsaturated fatty acids, antibiotics, nutritional supplements, enzymes, formulations containing zidovudine, macromolecular polypeptides, aromatic nitro and nitroso compounds and their metabolites useful as anti-viral and anti tumor agents, HIV protease inhibitors, antibiotics, viruses, pigments, steroids, oligopeptides, dipeptides, amino acids, flavor components, fragrance components, detergents and surface-active components, lipid derivatives of phosphonatides, amphiphilic polymers, adenosine derivatives, sulfated tannins, monoclonal antibodies, and metal complexes of water-soluble texathyrin.

27. An encapsulated product obtained by the method of claim 1 wherein said encapsulant is at least one member selected from the group consisting of amylases, proteases, lipases, pectinases, cellulases, hemicellulases, pentosanases, and phytases.

28. A food composition comprising an encapsulated product obtained by the method of claim 1 which is selected from the group consisting of ready-to-eat breakfast cereals, snacks, soups, salads, cakes, cookies, crackers, puddings, ice creams, yogurts, puddings, custards, baby foods, medicinal foods, sports bars, and beverages.

29. A food topping comprising an encapsulated product obtained by the method of claim 1 in granular form.